National Aeronautics and Space Administration

technology opportunity

Frequency-Doubled Wavelength-Division-Multiplexed Laser for Lidar

NASA Goddard Space Flight Center invites companies to license its Frequency-Doubled Wavelength-Division-Multiplexed Laser for Lidar method for producing multiple high-power, frequency-doubled laser beams at a fraction of the cost of current methods. This method allows the multiple fiber amplifiers to be replaced by just one amplifier. This will benefit several NASA missions, and offers greater spatial coverage and resolution, making it ideal for mapping, underwater communication systems, and detection of gases in the atmosphere.

Benefits

- **Less expensive**: Achieves significant cost reduction by replacing multiple optical amplifiers with only one
- **Lower SWaP**: Significantly reduces size, weight, and power (SWaP) through the use of just one optical amplifiers
- **High peak power**: Overcomes the inherent peak-power limitations of pulsed laser beams and provides high-power second harmonics
- **Scalable**: Accommodates high channel counts, resulting in fewer splits per channel
- **Flexible**: Can be extended to other frequency conversion applications, such as third harmonic generation, optical parametric oscillators (OPOs), optical parametric amplifiers (OPAs), etc.

Applications

- **Lidar**
  - Multi-beam swath mapping of the Earth and planetary surfaces
  - Coastal mapping
  - Underwater terrain mapping
  - Sensing/Detecting atmospheric gases
- **Underwater Communication**
  - Military applications
  - Communication for commercial or recreational scuba divers

Technology Details

Overview

Next-generation swath-mapping laser altimeters, using single photon ranging, require multiple green laser beams of short pulses with high peak power at a low duty cycle. This poses a challenge for fiber amplifiers, which are capable of high average powers but are limited in peak powers. Previous multiple-beam techniques included using multiple Yb-fiber amplifiers or using one or more bulk solid-state lasers and then splitting each beam into multiples. Goddard's technology circumvents this peak power limitation and allows multiple fiber amplifiers to be replaced by one amplifier.

How It Works

Goddard's technology utilizes inexpensive laser diodes to produce multiple beams with each beam having a different frequency (f1, f2, … fn) and being pulsed at separate, equally offset points in time. These beams are each modulated and then combined (multiplexed). The resulting single beam is then amplified using a single optical amplifier. This amplified beam is then frequency doubled via a second harmonic generator (SHG) cascade, each SHG in the cascade being tuned specifically to one of the original beam frequencies. Depending on the desired output usage, several methods can be used to "pick off" the individual frequency-doubled beams, providing a demultiplexed signal.

Why It's Better

Goddard's technology eliminates the current practice of having an expensive optical amplifier for each individual laser beam. The innovation also overcomes the limitation on peak power that fiber lasers/amplifiers have when running in pulsed mode. The technology also includes a number of variants that can be used in specific applications. For example, the multiple frequencies of the multiplexed beam can be split into subgroups before being run through the SHG cascade. The result is lower power loss and a reduction in thermal issues that can occur if all frequencies are handled by one SGH cascade.

Patents

NASA Goddard has filed a patent application for this technology.

Commercial Opportunity

This invention is part of NASA's Innovative Partnerships Program (IPP), which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing Frequency-Doubled Wavelength-Division-Multiplexed Laser for Lidar technology (GSC-15349-1) for commercial applications. For information and forms related to the technology licensing and partnering process, please visit the Licensing and Partnering page on Goddard's IPP Office Web site: http://ipp.gsfc.nasa.gov/lic-partnerships.html.

For More Information

If you are interested in more information or want to pursue transfer of this technology (GSC-15349-1), please contact:

Innovative Partnerships Program Office
NASA Goddard Space Flight Center
techtransfer@gsfc.nasa.gov
http://ipp.gsfc.nasa.gov